

CLAIMS

1. A heating apparatus comprising:
a burner,
5 a combustion gas passage for guiding combustion gas generated in the burner,
a primary heat exchanger for heating water by heat of the combustion gas and positioned in the combustion gas passage, and
a secondary heat exchanger for heating water by heat of the combustion
10 gas and positioned in the passage downstream of the primary heat exchanger,
wherein the primary and secondary heat exchangers are connected so that water having passed through the secondary heat exchanger should flow into the primary heat exchanger, and
wherein the secondary heat exchanger comprises a number of heat
15 receiving tubes arranged in parallel.
2. The heating apparatus as defined in claim 1,
wherein the primary heat exchanger is adapted to heat water using mainly sensible heat of the combustion gas and the secondary heat exchanger
20 is adapted to heat water using mainly latent heat of the combustion gas.
3. The heating apparatus as defined in claim 1,
wherein the heat receiving tubes of the secondary heat exchanger are bare tubes.
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4. The heating apparatus as defined in claim 1,
wherein the primary heat exchanger is a fin-and-tube heat exchanger.

5. The heating apparatus as defined in claim 1,
wherein the heat receiving tubes of the secondary heat exchanger make
up a three-dimensional structure in which the tubes are arranged vertically
5 and horizontally,
the number of the tubes arranged vertically being less than the number
of the tubes arranged horizontally.
6. The heating apparatus as defined in claim 1,
10 wherein the heat receiving tubes of the secondary heat exchanger are
arranged across flow of the combustion gas.
7. The heating apparatus as defined in claim 1,
wherein the heat receiving tubes of the secondary heat exchanger are
15 arranged in staggered rows.
8. The heating apparatus as defined in claim 1,
wherein the secondary heat exchanger comprises a pair of headers
between which the heat receiving tubes are arranged in parallel,
20 the headers each comprising a tube plate to which the heat receiving
tubes are fixed on its surface and a passage-forming member positioned at
the other surface of the tube plate so as to form a part of a water passage, and
the headers functioning as parts of walls of the combustion gas passage
extending from the burner to a gas-discharging portion.
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9. The heating apparatus as defined in claim 1,
having a plurality of the burners and a plurality of the combustion gas

passages, so that the apparatus consists mainly of a plurality of heating systems each constituted by at least one of the burners and at least one of the passages, and

having a plurality of the primary heat exchangers accompanying the
5 heating systems respectively,

wherein the secondary heat exchanger has a plurality of the heat receiving tubes extending over at least two of the heating systems.

10. A heating apparatus comprising:

10 a plurality of heating systems each having a burner and a combustion gas passage for guiding combustion gas generated in the burner, and

a heat exchanging means for heating water by heat exchange with the combustion gas,

wherein the heat exchanging means has a heat exchange circuit
15 constituted by a heat exchanger having a plurality of heat receiving tubes extending over at least two of the heating systems.

11. The heating apparatus as defined in claim 10,

the heat exchanger having a receptacle for accommodating the heat
20 receiving tubes,

the receptacle having a gas inlet and a gas outlet for guiding the combustion gas into and out of the receptacle, and a communicating passage that communicates between the gas inlet and the gas outlet, and

the heating apparatus further comprising a resistance member positioned
25 in the communicating passage and adapted to increase resistance against gas flow from the gas inlet to the gas outlet.

12. The heating apparatus as defined in claim 11,
wherein the resistance member is formed by a group of the heat receiving tubes arranged in a certain area more densely than the rest of the tubes arranged in the other area, so as to increase resistance against flow of
5 the combustion gas.
13. The heating apparatus as defined in claim 11,
wherein the resistance member is positioned across an imaginary straight line connecting the gas inlet and the gas outlet.
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14. The heating apparatus as defined in claim 11,
wherein the resistance member has a surface positioned substantially parallel to the gas inlet.
15. The heating apparatus as defined in claim 10,
wherein the heat exchanging means is constituted by a plurality of the heat exchange circuits.
16. The heating apparatus as defined in claim 10,
20 wherein the heat exchanging means is formed by a plurality of the heat exchange circuits arranged in rows along a flow direction of the combustion gas.
17. The heating apparatus as defined in claim 10,
25 further comprising a first thermal medium supplying channel and a second thermal medium supplying channel,
the first thermal medium supplying channel being one expected to

supply water or thermal medium for longer time duration than the second thermal medium supplying channel,

the heat exchanging means having at least a first heat exchange circuit and a second heat exchange circuit,

5 the first and second heat exchange circuits being connected to the first and second thermal medium supplying channels, respectively, and

the first heat exchange circuit being positioned upstream of the second heat exchange circuit in combustion gas flow.

10 18. The heating apparatus as defined in claim 15,

wherein the heat exchangers constituting the heat exchange circuits are arranged so as to thermally contact with one another.

19. The heating apparatus as defined in claim 10,

15 the heat exchanger having a receptacle for accommodating the heat receiving tubes,

the receptacle having a gas inlet and a gas outlet for guiding the combustion gas into and out of the receptacle,

the gas outlet being formed in an outlet-forming area predefined on a predetermined face of the receptacle, and

the outlet-forming area being covered with a gas-discharging member to define a space between the outlet-forming area and the gas-discharging member so that the combustion gas discharged from the gas outlet flows into the space.

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20. The heating apparatus as defined in claim 10,

wherein at least one of the heating systems has in the combustion gas

passage a sensible heat exchanging means for transferring mainly sensible heat of the combustion gas to water and a latent heat exchanging means for transferring mainly latent heat of the combustion gas to water,

at least one of the sensible and latent heat exchanging means is
5 constituted by a heat exchange circuit having a multi-tube heat exchanger.